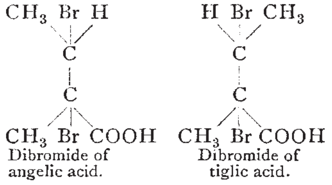
gation of the bromine addition products of angelic and tiglic acids, and was successful in showing that the two products were essentially different, exhibiting properties indeed so dissimilar that their identity was entirely out of the question. Although their similar constitution was indicated by melting-points differing by only one or two degrees, yet it was found that the crystals of the dibromide of angelic acid immediately reacted with water with production of a colourless oil, whilst the dibromide of tiglic acid remained unchanged in contact with water; moreover, the two compounds upon decomposition of their sodium salts, yielded two mono-brom-pseudo-butylenes, which differed essentially in their capability of reacting with alcoholic potash.

In the year 1890, however, Prof. Fittig, of Strassburg, who had previously investigated the subject in conjunction with Herr Pagenstecher, and had obtained *identical* bromine addition products from the two acids, published a paper in the *Annalen* in which he sought to show that the results of Herr Pückert were incorrect, and that the two substances were identical. Prof. Fittig has since requested Prof. Wislicenus to withdraw the work or substantiate it, and further charges Prof. Wislicenus with seeing facts through the veil of his theory. Unfortunately Prof. Wislicenus has been unable hitherto to meet the attack owing to domestic loss and serious illness, but at last he is able to publish the results of a really classical piece of work which he has carried through himself, and which not only demonstrates the truth of Herr Pückert's conclusions, but places the results beyond all criticism, and shows the singular cause of Prof. Fittig's inability to repeat them. It is indeed remarkable, but nevertheless true, that the fate of the theory of geometrical isomerism has actually been trembling in the balance owing to the different situation of the draught cupboards in the Leipzig and Strassburg laboratories. In the former laboratory they are placed *between* the windows, and in deep shadow; in the Strassburg laboratory they are *against* the windows, and are consequently brightly illuminated in daylight. Now Prof. Wislicenus shows that the dibromide of angelic acid is only formed in the absence of bright light, *rays of daylight intensity being absolutely fatal to its formation*. Hence Prof. Fittig only obtained the relatively more stable dibromide of tiglic acid, which in a good light is yielded by both angelic and tiglic acids. As the case is so remarkable, it may perhaps not be uninteresting to give a brief summary of the work of Prof. Wislicenus.

During the course of other researches concerning geometrical isomers, it was found that in order to obtain addition-products in which no internal re-arrangement of atoms had occurred, it was necessary to observe three conditions. One must operate at the lowest possible temperature, exclude light as much as possible, and take care that the halogen to be added is always present in tolerably large excess. When these three conditions are observed, the two respective and distinct bromine addition-products of angelic and tiglic acids are always obtained. They are probably represented by the formulæ—



Dibromide of angelic acid. Dibromide of tiglic acid.

The operation of preparation is best conducted as follows:—A quantity of bromine, at least half as much again as is required by theory, and dissolved in three times its weight of carbon bisulphide, is placed in a flask surrounded by iced water. The flask is fitted with a triply bored caoutchouc stopper, through one hole of which is inserted a thermometer, through a second an exit tube furnished with a calcium chloride drying tube, and through the third the end of a burette containing a solution of pure angelic or tiglic acid in five times its weight of carbon bisulphide. The draught cupboard is darkened as much as possible and then the acid solution is slowly allowed to run into the flask. After the expiration of a few hours the formation of the brominated compound is complete, and the carbon bisulphide may be evaporated away in a rapid stream of dry air.

The difference between the two compounds is apparent even at this early stage, for the tiglic compound commences to crystallize long before the removal of all the carbon bisulphide, and soon forms a snow-white mass of crystals. On the contrary, the angelic dibromide shows no sign of crystallization, remaining as an oil for some time after the removal of all the carbon bisulphide. Eventually it crystallizes to a hard yellowish mass. The only solvent from which it was found practicable to recrystallize the angelic dibromide was the pentane fraction of petroleum ether boiling at 33°–39°.

The melting-point of pure angelic dibromide is 86·5–87. That of tiglic dibromide is 87·5–88. The two substances behave quite differently upon resolidification. The former congeals to a transparent resinous mass, whilst the latter forms an opaque solid.

The most striking difference is apparent in their respective behaviour towards water. The dibromide of tiglic acid is only slightly soluble in water, and dissolves unchanged, crystallizing out again upon evaporation. The dibromide of angelic acid, however, instantly combines with the equivalent of one molecule of water, to form a curious unstable liquid, an oil of high refractive power, which is somewhat soluble in excess of water, and is again deposited upon evaporation. This liquid compound is also formed when the dibromide is exposed to moist air, while the dibromide of tiglic acid is not changed in a moist atmosphere. In dry air the angelic liquid compound again dissociates into the dibromide and water vapour. In fact the dibromide of angelic acid would appear to act as an excellent indicator of the hygroscopic state of the atmosphere.

The two dibromides show a further difference in solubility, the angelic compound being far more readily soluble in all the solvents experimented with.

Finally the crystals of the two compounds, although both belonging to the triclinic system, are absolutely unlike. From measurements made by Dr. Fock, they are shown to exhibit different forms, entirely different angles, and different disposition of optic axes.

From the above description it will be quite evident that the two compounds are certainly not identical.

In conclusion, Prof. Wislicenus gives the results of attempts to obtain the dibromide of angelic acid in bright sunshine in the open air, then when working in front of a window, and again when the experiment was performed upon a table in the centre of the laboratory. In the first case, instead of the angelic compound, 92·8 per cent. of the dibromide of tiglic acid was obtained, in the second case 89·6, and in the third case 88·7 per cent. These results render it perfectly clear why Prof. Fittig could not obtain the angelic compound in his experiments, and they also show how it is possible for two chemists, both working with a desire to ascertain the truth, occasionally to obtain results apparently at complete variance with each other.

A. E. TUTTON.

MARINE LABORATORIES IN THE UNITED STATES.[1]

ONLY in comparatively recent times has the tremendous importance of the bearing of the invertebrates upon the general questions of biology been appreciated. We have seen that some work was done upon these animals at an early date, when the minds of workers were not much troubled by theoretical considerations, but the study of the adult forms is so small a part of a real understanding of these animals that it was unsatisfactory work, and never became popular among investigators until embryological methods had been introduced.

Dr. Brooks has remarked that "nearly every one of the great generalizations of morphology is based upon the study of marine animals, and most of the problems which are now awaiting a solution must be answered in the same way."[2] We find the reason for this in the fact that the biology of the present day is a study of vital phenomena and of natural laws governing living things. The importance of the invertebrates depends, therefore, upon the fact that in them life exists under simplified conditions, affording opportunities for the study of questions for which higher forms are, with our present knowledge, too complex.

As the study of invertebrates has extended, it has become more and more desirable to have more favourable conditions for this work, more abundant facilities for collecting and opportunities for studying animals alive. Much of the early work was done upon specimens collected and stored in museums, but workers, both in this country and Europe, had frequently made excursions to the seacoast for the purpose of studying the invertebrate forms constituting so large a part of the marine fauna.

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[1] Reprinted from "Biological Teaching in the Colleges of the United States," by John P. Campbell, Professor of Biology in the University of Georgia; issued by the U.S. Bureau of Education.

[2] Johns Hopkins University Circulars, vol. vi., p. 37.

The unsatisfactory nature of this work was of course evident. Suitable accommodations and working appliances could not be provided under these circumstances, and desirableness of establishing permanent seaside laboratories was early felt. Nothing was done, however, in this country until 1871, when John Anderson, a wealthy citizen of New York, presented to Prof. Agassiz the island of Penikese in Buzzard's Bay, together with the sum of $50,000 with which to found a seaside station for the study of marine life. Another friend gave him a yacht of 80 tons burden for use in collecting. Agassiz had long wished for such a laboratory, and no one but himself could have aroused the necessary enthusiasm for carrying out the project. He soon set to work and built large laboratories, with suitable accommodations for a large number of workers. In 1873 they were opened for work. This constituted the first opportunity enjoyed by American students of studying marine animals in their native waters, with proper appliances for work. It inaugurated a new era in scientific research, being the first outward expression of an idea which has since taken a firm hold upon the investigators of the country. The death of Agassiz in December, 1873, put an end to the project. The buildings were used but two seasons and then abandoned.

Of this laboratory Prof. Whitman says :—

"At the close of the second and last season at Penikese, in 1874, Alexander Agassiz appealed to the colleges and all interested boards of education for support ; but all in vain, for not a single favourable reply was received, and so his intention to remove the laboratory to Wood's Holl was never carried out. Thus that great and memorable undertaking, after absorbing money enough to build and equip a most magnificent laboratory, was abandoned from lack of interest on the part of educational institutions rather than of means. Such a failure, it must be frankly confessed, is not one to inspire confidence, but its explanation removes the apparent grounds for discouragement. It was the marvellous personality of Prof. Agassiz that made Penikese a possibility. It was his magic influence that created that school, his commanding individuality that organized and vitalized it. All interests centred in him so completely that with his sudden removal the enterprise was left without a soul. The school had no coherency except in his magnetic power and intellectual strength, and the moment these elements of stability were withdrawn, collapse followed as a natural and inevitable consequence. Then, too, it should be remembered that Prof. Agassiz lived just long enough to demonstrate the impracticability of maintaining such a school in such a locality, but unfortunately not long enough to convince the scientific world of its utility. The school was an experiment ; its master was stricken down before it could be fairly tested, and the times were not ripe for it."

The establishment of this laboratory was an event of the greatest significance because of its bearings upon the history of education. Not only was Penikese the first biological station established in this country, and, indeed, in the world, but it was the beginning of the summer-school movement which has spread so generally over the country, and which, it should be noted, began with original research and finally extended to include the work of elementary instruction.

The movement met with the cordial support of naturalists everywhere, and was almost immediately followed by the establishment of Dohrn's magnificent station at Naples. Soon after, in 1875, a seaside station was established at Helder by the Netherlands Zoological Society, and other smaller ventures followed in Europe.

The need of opportunities for seaside study in the United States was too generally felt by those who had come under Agassiz's influence for the project to be allowed to stop. The advantages of this method of work over museum study had impressed themselves at least upon a few workers, and accordingly we find several attempts made to found new laboratories. They differed in character and aims, but all agreed in being founded upon the one idea of studying marine animals in their native waters.

The most direct successor of the Penikese laboratory is the private laboratory of Prof. Alexander Agassiz at Newport. While this building is constructed on a much smaller scale than that at Penikese and is open only to a limited number of workers, yet it is prominent for the elegance of its appointments and its conveniences for work.

The first laboratory for seaside study established in this country after the abandonment of Penikese was maintained by the Peabody Academy of Sciences, under the guidance of Prof. Packard, with the co-operation of Prof. Kingsley and others. This laboratory was for elementary instruction rather than research, and remained in existence only from 1876 to 1881.

In 1878 the trustees of the Johns Hopkins University made an appropriation to allow a party of workers to spend some time in seaside study. The party was under the guidance of Dr. W. K. Brooks, who had himself been a pupil of Agassiz and a member of the Penikese laboratory. The location selected was at the lower part of the Chesapeake Bay, from which the name of Chesapeake Zoological Laboratory was chosen. No permanent buildings were erected, as it was intended, if possible, to change the location from year to year ; but an outfit of boats and collecting apparatus was provided. The summers of 1878 and 1879 were spent about the lower part of Chesapeake Bay at Crisfield, Md., and Fort Wool, Va., at which places special attention was given to the development of the oyster.

At the opening of the third season, in 1880, the need was felt of a locality that would offer a greater variety of objects for study, and accordingly the summers of 1880–82 were spent at Beaufort, N.C. This locality proved especially favourable, since sand bars, mud flats, salt marshes, and land-locked salt water, within easy reach, gave a large variety of different rare forms, and there was also abundant ocean dredging. A sufficient appropriation was made in 1880 to purchase a steam launch and a sloop, which put the workers in a position to take every advantage of their opportunities.

In 1883 a special study of oyster beds made a return to the mouth of the Chesapeake Bay necessary, and that season was spent at Hampton, Va., but the following two seasons were again spent at Beaufort.

In 1886 the need of a more southern location was felt, and the Bahama Islands seemed to offer an inviting field. The summer of 1886 was therefore spent at Green Turtle Cay, and the following summer at Nassau, New Providence.

Financial difficulties temporarily stopped the work of the laboratory, but it is announced that it will be reopened in the summer of 1891.[1]

It is difficult to summarize the work of this laboratory, and none the less so to over-estimate its importance. It enjoys the distinction of being the first marine laboratory ever carried successfully into operation in the United States, and its work was entirely original research. The character of work done differed from year to year, according to the facilities which the different localities offered ; but in general it may be said that embryology received most attention, while considerably less was devoted to the discovery and description of new species. The methods employed, as well as the new facilities enjoyed, made it possible to apply effective means of solution to many problems previously obscure, as well as opening many questions in regard to which nothing had been done.

Of the lasting value of the work it is perhaps too early to speak, but the fact that over one hundred papers, based upon work there performed, have readily found publication in the best journals of this country and Europe, as well as the fact that much of the work has already found its way into standard text-books, gives strong testimony to its value.

The Chesapeake Zoological Laboratory may be regarded as the successor of the Penikese laboratory to the extent that its aims are the same, but it differed in not being generally open to the workers of the country. Arrangements were not made for large numbers, and those who were present were mainly students of the Johns Hopkins University. During the nine years that this laboratory remained in existence, there were in all fifty investigators present, and the average length of each session was nearly two months.

The need was felt, especially in that portion of the country where Agassiz's influence was more directly exerted, of establishing a laboratory on a larger scale, and open to a larger number of workers, and the first step taken in this direction was the founding of a laboratory by the Boston Society of Natural History. In their report for 1881 these words occur:

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[1] Shortly after the above was written, Kingston, Jamaica, was chosen as a suitable locality, and a party of advanced workers, numbering about fourteen in all, were present from May until September.—September 21, 1891.

"It has been considered desirable to found a summer laboratory sufficient to supply the needs of a class of persons who have begun to work practically under our direction, but have hitherto had no convenient means for pursuing their studies on the seashore. . . . . We are sure that such a laboratory is needed for a limited number of persons, such as our own pupils in natural history, and some of the teachers of the Boston public schools, about a dozen in all, but we are not sure of any real demand outside of these."

Arrangements for laboratory work were speedily made at Annisquam, Mass. Boats and appliances for collecting were at once provided, and in the spring of 1881 a circular was issued announcing the opening of the new laboratory. From this the following extracts are taken:—

"The liberality and co-operation of the Woman's Educational Association enable the Boston Society of Natural History to announce that a seaside laboratory, under the direction of the curator (Prof. Alpheus Hyatt), and capable of accommodating a limited number of students, will be open at Annisquam, Mass., from June 5 to September 15.

"The purpose of this laboratory is to afford opportunities for the study and observation of the development, anatomy, and habits of common types of marine animals, under suitable direction and advice. There will, therefore, be no attempt during the coming summer to give any stated course of instruction or lectures.

"It is believed that such a laboratory will meet the wants of a number of students, teachers, and others who have already made a beginning in the study of natural history."

Twenty-two persons were attracted to the Annisquam laboratory during its first season. Prof. Hyatt, in his report for 1882, remarks as follows:—

"The great need of an institution for teaching field work cannot be properly estimated by the number of those who are attracted by the opening of such opportunities for study. The mental condition of those who attend, and what it has done for them, and the sphere of influence which it reaches through them, are the only true standards by which its present and future usefulness can be properly measured. Nearly all the pupils were persons who could be termed 'well educated;' nevertheless they were, with the exception of some who had already worked in the laboratory or field, entirely unable to obtain knowledge with their own eyes and hands, and had even acquired a notion that this was not possible for anybody except the trained man of science. Several of these teachers, after their work was finished, expressed their gratefulness for the new powers the course had developed in themselves, and the fascinating pleasure they had experienced in learning to use their own eyes and hands in the study of things hitherto unapproachable for their uncultivated senses except through the deceptive mediation of books. When it is remembered that these teachers influence and mould the minds of thousands of young persons it is at the same time proved that what this laboratory has done and can do is not to be estimated by the number of its own pupils."

The success of the undertaking seemed assured, and arrangements were made for its continuance during the five years following. The number of students fluctuated greatly, falling to ten in the third year, and running up in the sixth year to twenty-six.

During these six years the laboratory was carried on jointly by the Boston Society of Natural History and the Woman's Educational Association of Boston. It has been the policy of both of these associations to originate new enterprises, but to turn them over when well started into other hands. It seemed in 1887 that the time had come when the maintenance of the laboratory should be put on a firmer basis. It had been supported long enough to demonstrate its practicability and usefulness. The demands upon it had increased. It was no longer an experiment. The associations believed that a permanent organization should be effected, the working facilities increased, and the whole established on a larger scale. Moreover, it seemed that something more might be done to give the laboratory a wider sphere of usefulness in advancing knowledge of marine like. Great as was its work in teaching, it seemed to depend for its support upon a circle of people too small for the extent of its benefits. It seemed desirable that a change should come which would lead to a more widespread interest in the laboratory, and bring together more investigators. The Marine Biological Laboratory was the result of this movement.

While space will permit but a brief account of this laboratory, its history, development, aims, &c., it may be said that the one point which distinguished it from the Annisquam laboratory was the prominence given to research. Students are received, but from the outset there has been a settled determination to so adjust the claims of each as to secure the greatest amount of efficiency and do most to advance science. The organization was therefore effected so as to secure a permanent staff of investigators, who would always be present, increasing knowledge by their own work, and by their example stimulating others to follow. Moreover, the principle was thoroughly recognized that the best investigation is prompted by the work of teaching. The best investigator is often the best teacher, but the work of teaching reacts upon the work of investigation, influencing it for the better.

The experience of the laboratory shows that these points, which had previously been carefully considered, were well taken. Various means were resorted to for providing funds, and in March, 1888, the laboratory was incorporated.

Wood's Holl was chosen as a locality because of its convenience, accessibility, and the variety of its land and marine flora and fauna. The building was at once begun, and finished in time for work during the summer. Circulars could not be issued until after most of the colleges had disbanded for the summer, and yet during the first season seven investigators and eight students were attracted to the laboratory.

In subsequent years the growth has been a steady one. The number of workers has greatly increased, and even now, when only its third season has been passed, it is stated that the space is insufficient to meet the demands upon it; the facilities for collecting are too small, and the staff of instructors is not large enough for their classes. Its usefulness is now established, and the time is ripe for it. To it in great measure the United States must look for the advancement of biology. Let us hope that its trustees, all of whom are working biologists, may be successful in placing the laboratory upon such a financial basis that its full possibilities for usefulness may be realized.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. Hill, Master of Downing College, has been appointed Chairman of the Natural Science Tripos Examiners for 1893. An election to an Isaac Newton Studentship in Astronomy, Astronomical Physics, and Physical Optics, will be held in the Lent term 1893. Candidates must be B.A.'s, and under twenty-five years of age on January 1. The emoluments are £200 per annum for three years. Applications are to be addressed to the Vice-Chancellor between January 17 and 27, with testimonials or other evidence of competency.

Dr. Lorrain-Smith, M.D. Edin., Demonstrator of Physiology at Oxford, and Dr. F. F. Wesbrook, M.D., Manitoba, Professor of Pathology at Winnipeg, have been elected John Lucas Walker Students in Pathology. The Managers express their high approval of the valuable researches conducted by the late student, Dr. A. A. Kanthack, of St. John's College. The State Medicine Syndicate state that, at the two examinations held in April and October, 1892, there were in all sixty-four candidates, of whom thirty-five received Diplomas in Public Health. The fee in future will be five guineas for each of the two parts of the examination in State Medicine.

Examinations for open scholarships and exhibitions in Natural Science will be held in twelve of the Colleges in December and January next. A list giving the conditions and value of the scholarships is published in the *University Reporter* of November 12, pp. 198, 199.

SCIENTIFIC SERIALS.

Wiedemann's Annalen der Physik und Chemie, No. 10.—Refraction and dispersion of light in metal prisms, by D. Shea. Thin prisms of gold, silver, nickel, and cobalt were prepared by the electrolysis of cyanide solutions by Kundt's method. Prisms of platinum were also prepared by the disintegration of platinum foil. A piece of foil 4 mm. broad and 0·02 mm. thick placed perpendicularly to a piece of plate glass at a distance of 0·5 mm. produced under the action of a current of 20 amperes a double wedge-shaped layer of oxide in half an hour.